LOPHODIPLOSIS TRIFIDA GAGNÉ (DIPTERA: CECIDOMYIIDAE), A STEM-GALLING MIDGE WITH POTENTIAL AS A BIOLOGICAL CONTROL AGENT OF *MELALEUCA QUINQUENERVIA* (MYRTACEAE)

M. PURCELL[1], S. WINEWRITER[2] and B. BROWN[1]

[1]*CSIRO Entomology, United States Department of Agriculture, Agricultural Research Service, Australian Biological Control Laboratory, 120 Meiers Road, Indooroopilly, Qld 4068 (Email: matthew.purcell@csiro.au)*

[2]*United States Department of Agriculture, Agricultural Research Service, FDACS Florida Biocontrol Laboratory, PO Box 147100, Gainesville, Florida 32614-7100, USA*

Abstract

The gall midge *Lophodiplosis trifida* Gagné was originally described as an inquiline of galls formed by three other *Lophodiplosis* Gagné species on *Melaleuca dealbata* and *M. quinquenervia*. However, field observations conducted throughout the native range of *M. quinquenervia*, coupled with replicated laboratory studies, have shown that *L. trifida* forms unique stem galls on *Melaleuca* species within the *M. leucadendron* complex. *Melaleuca quinquenervia* is an invasive weed in Florida, USA and *L. trifida* is a candidate biological control agent of that species.

Introduction

Melaleuca quinquenervia S. T. Blake is a federally and state listed invasive tree in southern Florida, USA (Turner *et al.* 1998). Since 1996, explorations for host-specific natural enemies have been conducted by the United States Department of Agriculture, Agriculture Research Service, Australian Biological Control Laboratory (USDA-ARS ABCL) throughout the range of *M. quinquenervia* in Australia.

A gall-forming cecidomyiid fly, then undescribed, was first collected in 1995 from *M. quinquenervia* growing in Queensland, by ABCL scientist J. K. Balciunas. It was described subsequently as *Lophodiplosis trifida* Gagné by Gagné *et al.* (1997), who reported it as an inquiline of three other *Lophodiplosis* Gagné galls – in leaf blister galls with *L. indentata* Gagné and *L. denticulata* Gagné on *M. quinquenervia*, and in bud rosette galls with *L. bidentata* Gagné on *M. dealbata* S. T. Blake (Gagné *et al.* 1997).

Since then, ABCL scientists have collected *L. trifida* from unique stem galls throughout the native range of *M. quinquenervia*. Specimens were sent to R. J. Gagné, who confirmed their identity. Voucher specimens are held at the Australian National Insect Collection, Canberra (ANIC) and the U.S. National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Observations

Lophodiplosis trifida galls young shoots, predominantly during the autumn-winter period, when a flush of young foliage is produced by *M. quinquenervia* trees following flowering. The galls are variable in size and shape and can persist on the plant for long periods, resulting in deformed

branches. Close or overlapping utilisation of host tissue by *L. trifida*, *L. indentata*, *L. denticulata* and *L. bidentata* accounts for *L. trifida*'s original designation as an inquiline in other *Lophodiplosis* galls. In the absence of congeners, colonies of *L. trifida* have been established and sustained on young seedlings and plants of *M. quinquenervia* for many generations at ABCL. *Lophodiplosis trifida* readily galls the stems, curtailing shoot growth, that can sometimes lead to death of the plants.

Discussion

The discovery that *L. trifida* is a stem galler of *M. quinquenervia*, rather than an inquiline, is significant, given that this particular gall possesses some of the traits considered desirable for biological control of weeds (Dennill 1988, Harris and Shorthouse 1996). The larvae of *L. trifida* live within the gall, the galled shoots occur at high densities, gall development spans the entire growth phase of the plant and gall development severs vascular tissue.

As part of a management plan for control of *M. quinquenervia*, three biological control agents have been introduced to Florida (USA) by scientists at the USDA-ARS Invasive Plant Research Laboratory (IPRL) since 1997, including a bud gall fly *Fergusonina turneri* Taylor (Goolsby *et al.* 2000, Davies *et al.* 2001). However, additional natural enemies are required that attack other plant stages. Elsewhere, gall formers have been used extensively in weed biological control programs (Julien and Griffiths 1998).

Initial screening of non-*Melaleuca* myrtaceous species by ABCL indicated that the host range of *L. trifida* is limited to *Melaleuca* species in the *M. leucadendron* complex. As a result, researchers of the IPRL and ABCL selected *L. trifida* to be imported and subjected to additional host range testing at the Florida Department of Agriculture and Consumer Services, Division of Plant Industry (FDACS DPI) quarantine facility in Gainesville, Florida, USA, in 2003.

Acknowledgements

We wish to thank ABCL staff members Jeff Makinson, Ryan Zonneveld and Dalio Mira for their assistance with field collections and observations, and Dr R. J. Gagné (USDA-ARS) for identification of specimens.

References

DAVIES, K.A., MAKINSON, J. and PURCELL, M.F. 2001. Observations on the development and parasitoids of *Fergusonina/Fergusobia* galls on *Melaleuca quinquenervia* (Myrtaceae) in Australia. *Transactions of the Royal Society of South Australia* **125**: 45-50.

DENNILL, G.B. 1988. Why a gall former can be a good biocontrol agent: the gall wasp *Trichilogaster acaciaelongifoliae* and the weed *Acacia longifolia*. *Ecological Entomology* **13**: 1-9.

GAGNÉ, R.J., BALCIUNAS, J.K. and BURROWS, D.W. 1997. Six new species of gall midges (Diptera: Cecidomyiidae) from *Melaleuca* (Myrtaceae) in Australia. *Proceedings of the Entomological Society of Washington* **99**: 312-334.

GOOLSBY, J.A., MAKINSON, J.R. and PURCELL, M.F. 2000. Seasonal phenology of the gall-making fly *Fergusonina* sp. (Diptera: Fergusoninidae) and its implications for biological control of *Melaleuca quinquenervia*. *Australian Journal of Entomology* **39**: 336-343.

HARRIS, P. and SHORTHOUSE, J.D. 1996. Effectiveness of gall inducers in weed biological control. *Canadian Entomologist* **128**: 1021-1055.

JULIEN, M.H. and GRIFFITHS, M.W. (eds.). 1998. *Biological control of weeds: a World catalogue of agents and their target weeds*. 4th edition. CAB International, Wallingford, United Kingdom; 223 pp.

TURNER, C.E., CENTER, T.D., BURROWS, D.W. and BUCKINGHAM, G.R. 1998. Ecology and management of *Melaleuca quinquenervia*, an invader of wetlands in Florida, U.S.A. *Wetlands Ecology and Management* **5**: 165-178.